

GaAs Solar Cell Development

Hughes Research Laboratories
3011 Malibu Canyon Road
Malibu, CA 90265

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INTRODUCTION

The objective of this program is to optimize the (AlGa)As-GaAs solar cells being fabricated at HRL for radiation damage. Three sets of GaAs cells will be fabricated during the course of the program and subjected to 1 MeV irradiation at JPL. These cells will be studied for radiation damage and recovery by temperature anneals up to 250°C.

During the last quarter we have been experimenting with gradual changes in the fabrication schedule for the epitaxial structure to enable us to reduce the junction depth to below 0.5 μm . Such a step has been shown desirable during our past studies on radiation damage in GaAs cells. Cells with these characteristics are now being fabricated and the first set of these will be delivered to JPL in about two weeks.

EXPERIMENTAL

Phase I of the program has emphasized the fabrication of GaAs cells with junction depth $\sim 0.3 \mu\text{m} \pm 0.1$. The growth temperatures have been lowered below 800°C and the cooling rates adjusted to permit the growth of structures with window layers of (AlGa)As less than 0.5 μm in thickness. A power conversion efficiency of $\sim 16\%$ (AM0) will be maintained in these cells. The parameters for the first set of cells is given in Table 1.

Our initial experiments under the conditions of growth mentioned above produced cells with typical characteristics shown in Fig. 1 - Fig. 4. As can be seen, the series resistance of the cells is high, causing a reduction in fill factor. One of the main reasons for this characteristic is the extremely low thickness of the window layer.

The growth schedule has been readjusted and the cells grown under the new conditions already have been processed. Their characteristics seem to be acceptable and they are presently going through their final fabrication steps (AR coating and testing). Four of these cells, along with n-type buffer layers and a set of mesa diodes, will be ready for delivery to JPL within the next two weeks.

TASKS FOR THE NEXT REPORTED PERIOD

1. Delivery of the first phase cells to JPL.
2. Testing of the first phase cells before and after irradiation.
3. Annealing studies on the radiated cells.
4. Fabrication of the second phase cells.

Table 1
(AlGa)As-GaAs Solar Cell Parameters

(AlGa)As layer thickness:		less than 0.5 μm
p^+ carrier conc.	=	$1 \times 10^{18} \text{ cm}^{-3}$
Diffused p layer (x_j)	=	$0.3 \mu\text{m} \pm 0.1 \mu\text{m}$
" " carrier conc.	=	$1 \times 10^{18} \text{ cm}^{-3}$
n - buffer layer thickness	=	$>10 \mu\text{m}$
" " carrier conc.	=	$1 \times 10^{17} \text{ cm}^{-3}$
n^+ substrate thickness	=	12 mil
" " carrier conc.	=	$7 \times 10^{17} \text{ cm}^{-3}$
Number of fingers	=	24
p contact	=	Au-Zn-Ag
n contact	=	Au-Ge-Ni-Ag
p $\text{Al}_x\text{Ga}_{1-x}\text{As}$	=	$x \geq 0.90$
Cell size	=	$2 \times 2 \text{ cm}^2$

Before AR Coating

Cell # 2138

7-28-78

Fig. 1 Photo i-v characteristics

(AlGa)As - GaAs Cell # 2138

Before A.R. coating

I (mA)

100

50

volts

0.5

1.0

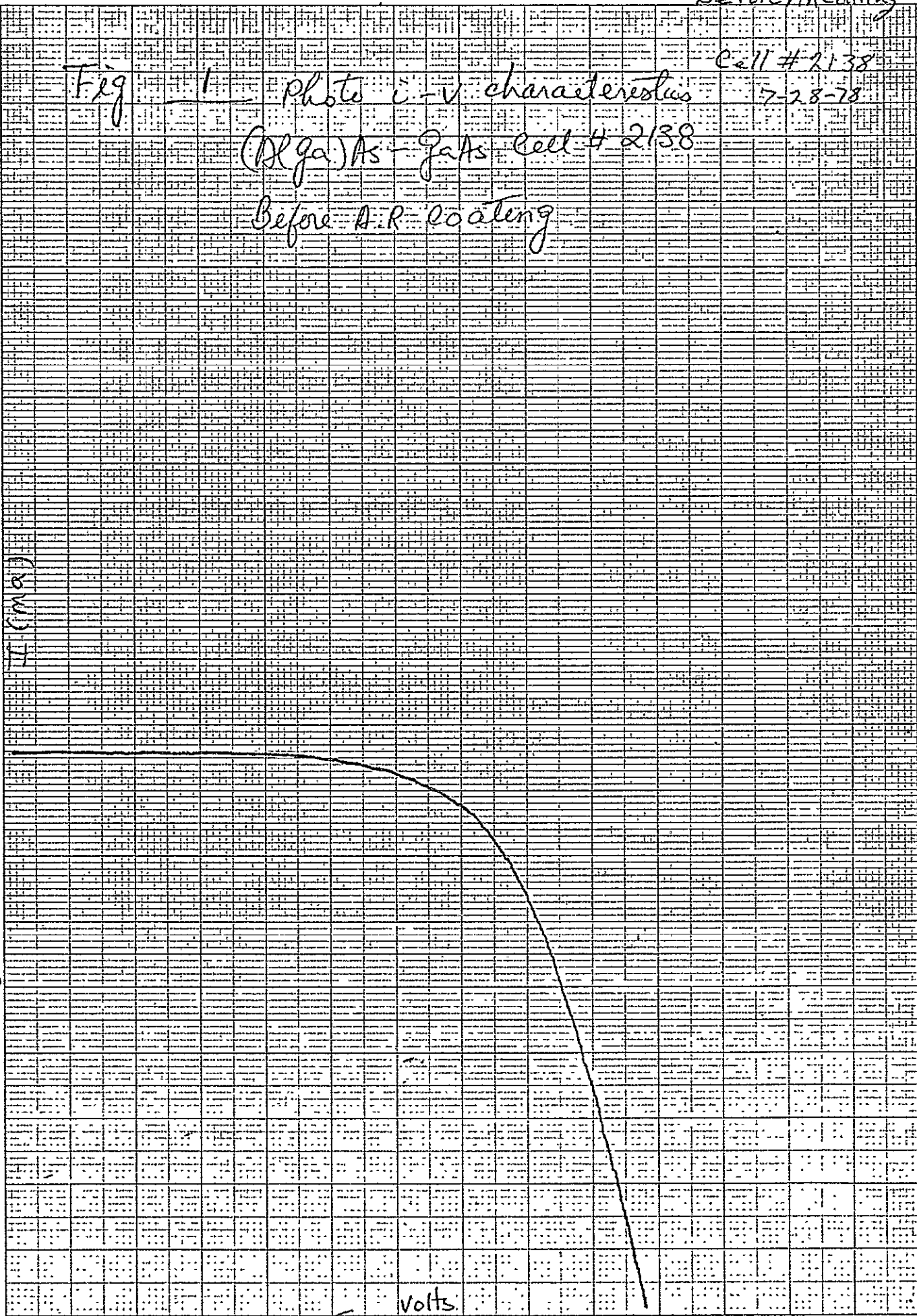


Fig 2

Photo $i-v$ characteristics 450°C 2min
 (AlGa)As - GaAs Cell # 2142
 Before A.R. coating

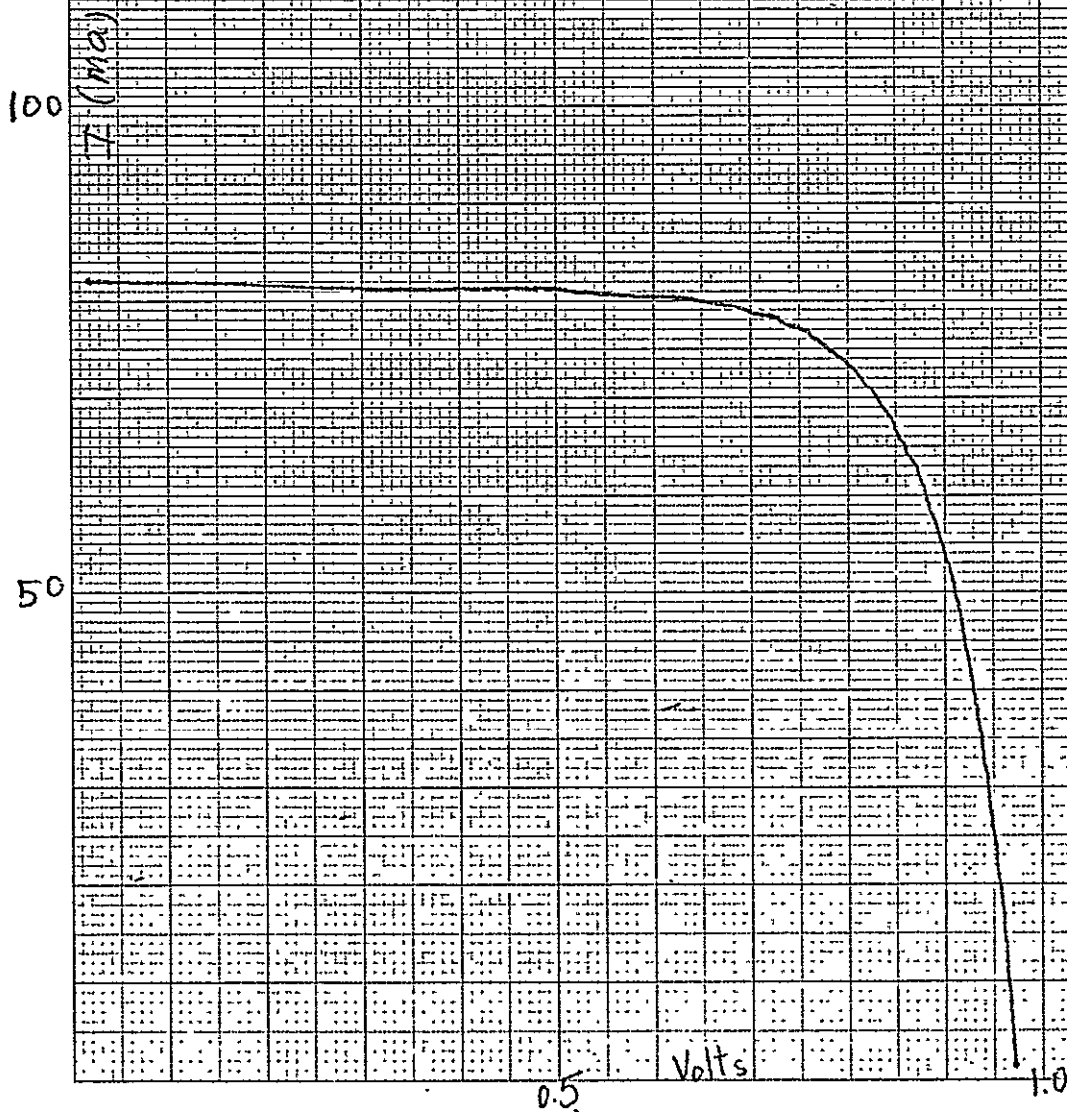
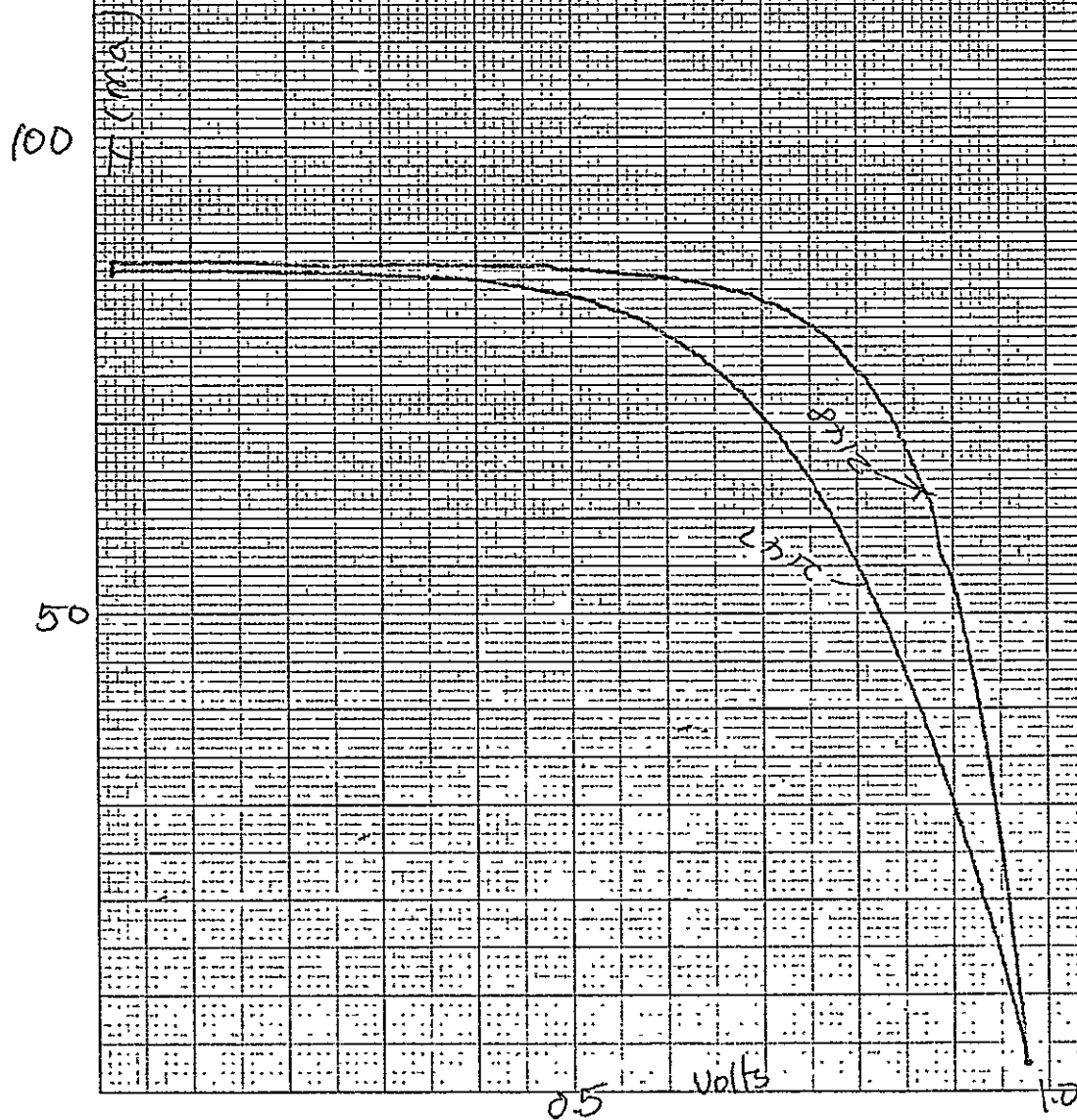


Fig. 3 Photo i-v characteristics
(AlGa)As = GaAs cell # 2147 and 2148
Before A-R coating



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2160

Fig. 4 Photo i-v characteristics
(AlGa)As - GaAs cell # 2160
Before A.R. Coating

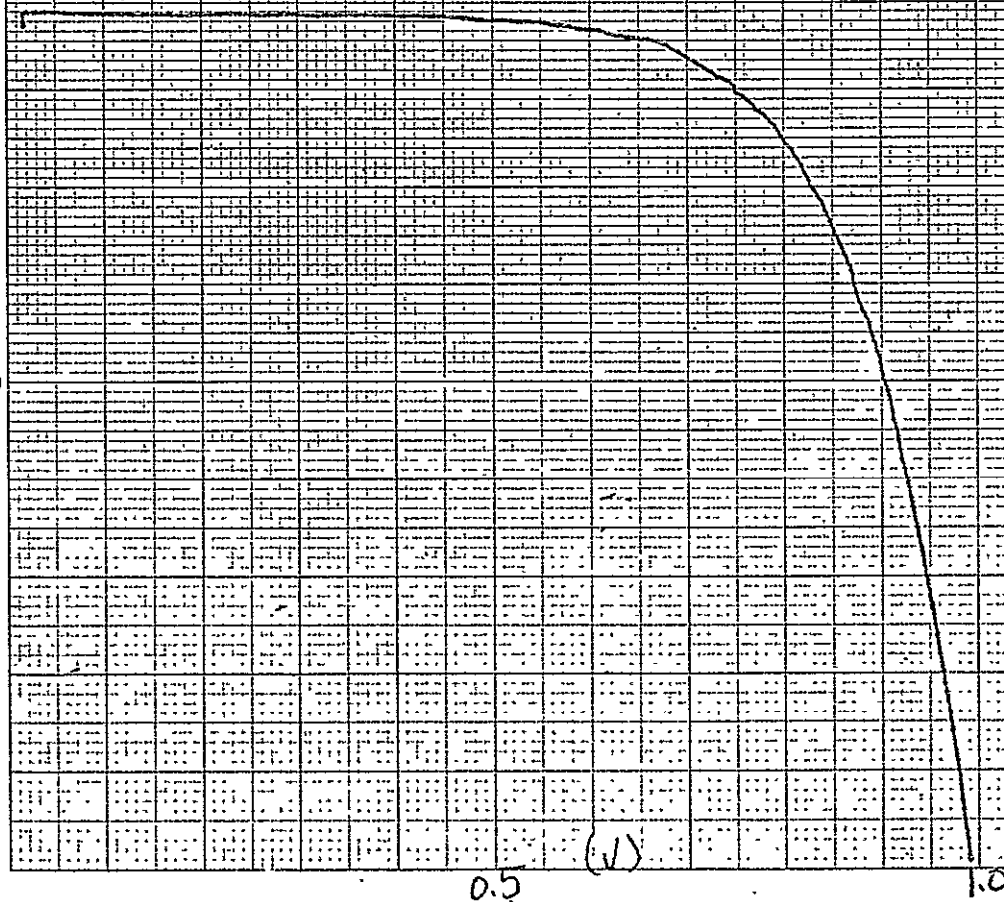
100 I_p (mA)

50

(V)

0.5

1.0



PROGRAM SCHEDULE

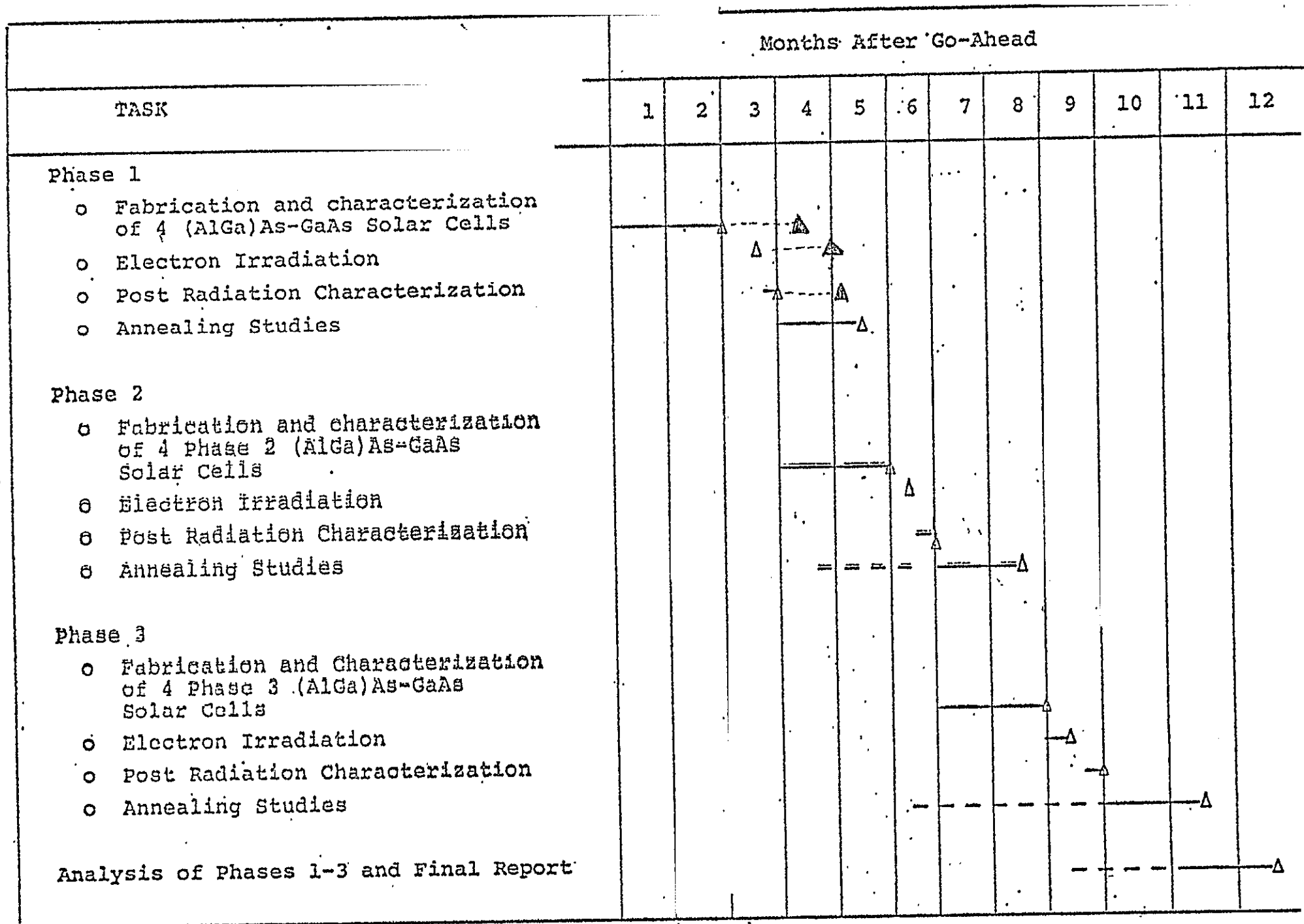


Figure 3-1